Replacement Sheet
Title: DIGITAL DATA COMPRESSION
ROBUST RELATIVE TO
TRANSMISSION NOISE
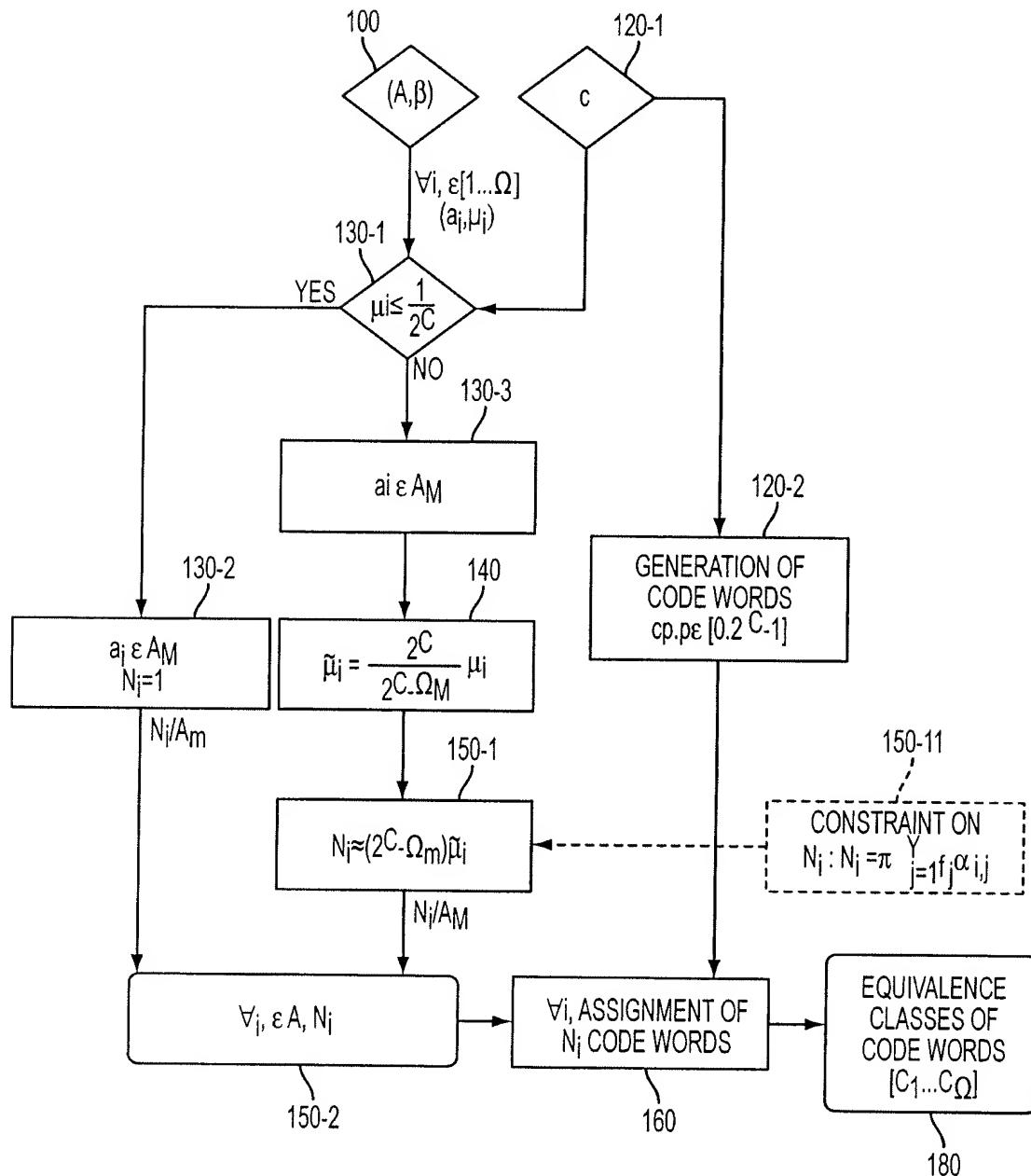Inventor(s): Herve JEGOU et al
Appl. No.: 10/521,963

FIG. 1

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FIG. 2

CLASS C_i	CODE WORD $C_{i,q}$	SYMBOL a_i	N_i=CARD (C_i)	PROBABILITY μ_i	STATE q
C_1	0000 0001 0010 0011 0100 0101	a	6	0.43	0 1 2 3 4 5
C_2	0110 0111 1000 1001 1010	b	5	0.30	0 1 2 3 4
C_3	1011 1100 1101 1110	c	4	0.25	0 1 2 3
C_4	1111	d	1	0.02	0

FIG. 2A

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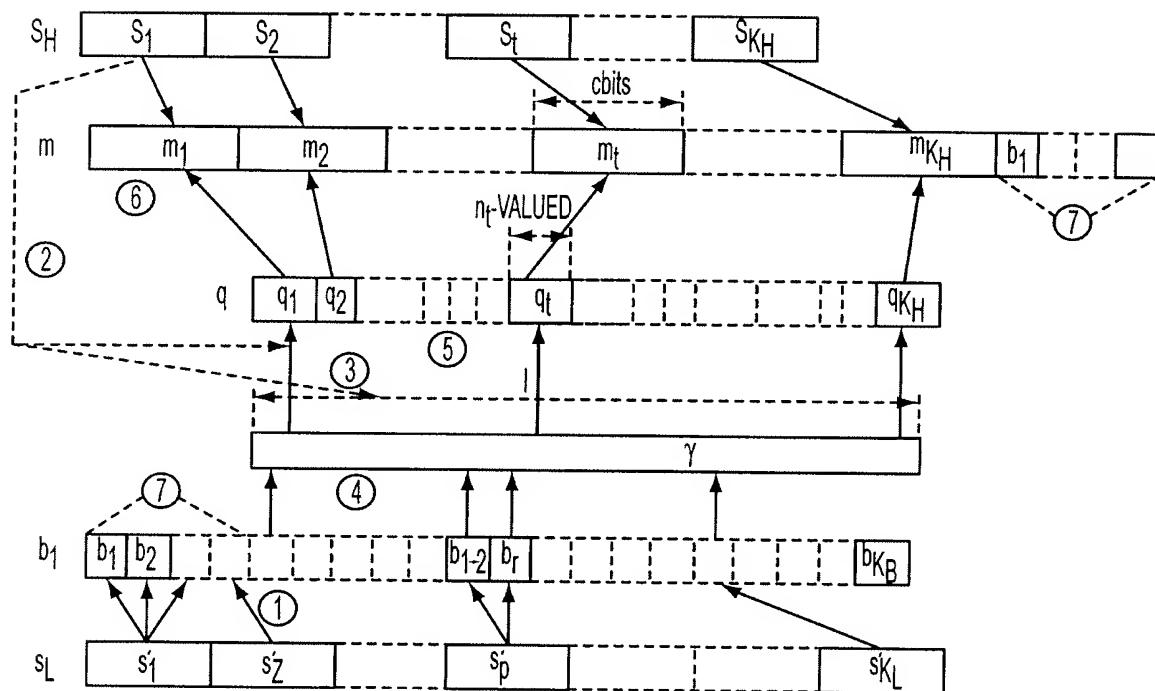Inventor(s): Herve JEGOU et al
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S_H
$S_1,...,S_t,...,S_{K_H}$ — 2-1

READ TABLE OF MULTIPLEXED CODES — 2-2

$\forall t \, \varepsilon \, [1..K_H], \, n_t$ — 2-3

K_H
$\Lambda = \Pi_t = 1 \, n_t$ — 3-1

$K_B = LOG_2([\Lambda])$ — 3-2

— 4-11
REDUCTION OF THE PART OF SH TO BE MULTIPLEXED
$K_H = K_H \, \dfrac{K_B}{K_B'}$

$K_B < K_B'$ — 4-1
YES
NO

S_L — 1-1

REVERSIBLE ENCODING — 1-2

b
$b_1,...,b_t,...,b_{K_B}$ — 1-3

DIVIDE FLOW b INTO TWO PARTS — 4-2

MULTIPLEXED PART
$b_{K_B}K_B'+1,...,b_t,...b_{K_B}$ — 4-3

CALCULATE DESCRIPTION VALUE OF FLOW S_L
$\sum_{r=1}^{K_H} b_r + K_B - K_B' 2^{r-1}$ — 4-4

ITERATIVE EUCLIDIAN DECOMPOSITION ON $n1,...n_{k_H}$deγ — 5-1

γ — 4-5

CONCATENATED PART
$b_1,...,b_t,...b_{K_B}-K_B'$ — 7-1

FLOW OF STATES q
$q = q_1,...q_{K_H}$ — 5-2

CONCATENATION OF MULTIPLEXED FLOW m AND NON-MULTIPLEXED PART OF b — 7-2

DETERMINATION OF CODE WORDS BY READING TABLE
$= \forall t, \, mt = f(s_t, q_t)$ — 6-1

MULTIPLEXED FLOW:
$m = m_1,...,m_{K_H}$ — 6-2

TRANSMITTED FLOW — 7-3
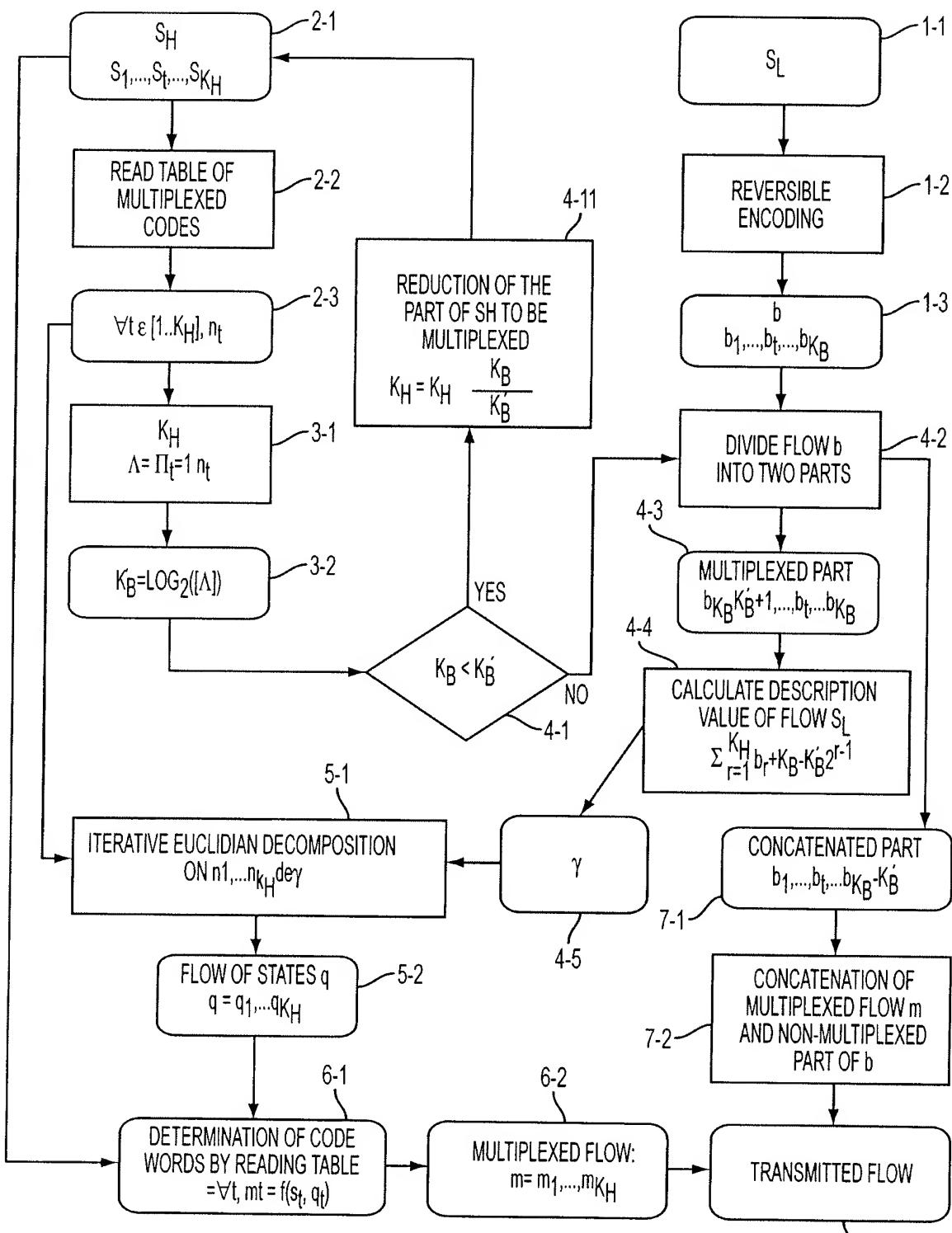
FIG. 3

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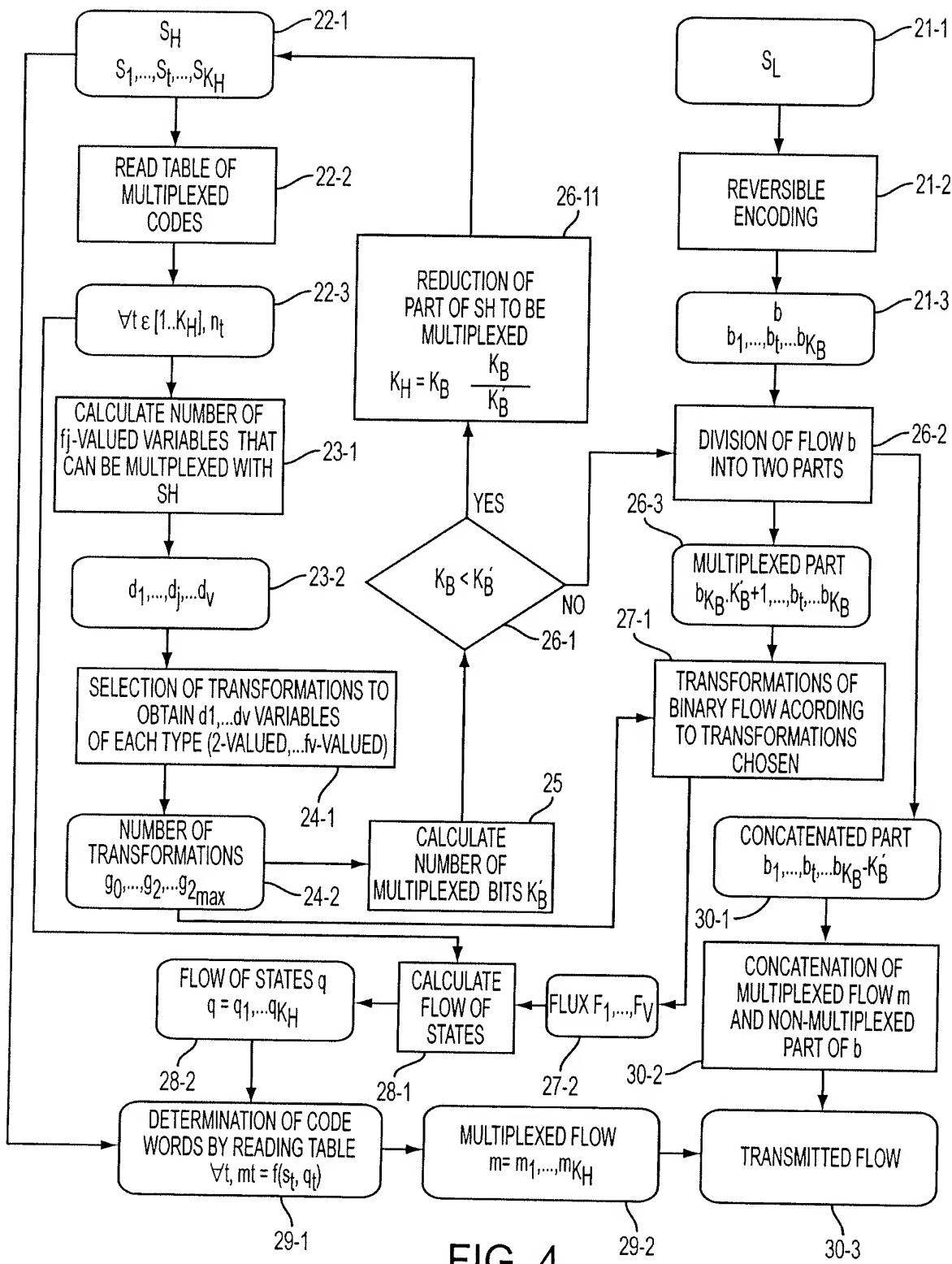Inventor(s): Herve JEGOU et al
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FIG. 4

Flowchart blocks:

- **22-1** S_H $S_1,...,S_t,...,S_{K_H}$
- **21-1** S_L
- **22-2** READ TABLE OF MULTIPLEXED CODES
- **21-2** REVERSIBLE ENCODING
- **22-3** $\forall t \,\varepsilon\, [1..K_H], n_t$
- **21-3** b $b_1,...,b_t,...b_{K_B}$
- **26-11** REDUCTION OF PART OF SH TO BE MULTIPLEXED $K_H = K_B \dfrac{K_B}{K'_B}$
- **23-1** CALCULATE NUMBER OF f_j-VALUED VARIABLES THAT CAN BE MULTPLEXED WITH SH
- **26-2** DIVISION OF FLOW b INTO TWO PARTS
- **23-2** $d_1,...,d_j,...d_v$
- **26-1** $K_B < K'_B$ YES / NO
- **26-3** MULTIPLEXED PART $b_{K_B.K'_B+1},...,b_t,...b_{K_B}$
- **24-1** SELECTION OF TRANSFORMATIONS TO OBTAIN $d_1,...d_v$ VARIABLES OF EACH TYPE (2-VALUED,...f_v-VALUED)
- **27-1** TRANSFORMATIONS OF BINARY FLOW ACORDING TO TRANSFORMATIONS CHOSEN
- **24-2** NUMBER OF TRANSFORMATIONS $g_0,...,g_2,...g_{2max}$
- **25** CALCULATE NUMBER OF MULTIPLEXED BITS K'_B
- **30-1** CONCATENATED PART $b_1,...,b_t,...b_{K_B}-K'_B$
- **28-2** FLOW OF STATES q $q = q_1,...q_{K_H}$
- **28-1** CALCULATE FLOW OF STATES
- **27-2** FLUX $F_1,...,F_V$
- **30-2** CONCATENATION OF MULTIPLEXED FLOW m AND NON-MULTIPLEXED PART OF b
- **29-1** DETERMINATION OF CODE WORDS BY READING TABLE $\forall t, m_t = f(s_t, q_t)$
- **29-2** MULTIPLEXED FLOW $m = m_1,...,m_{K_H}$
- **30-3** TRANSMITTED FLOW

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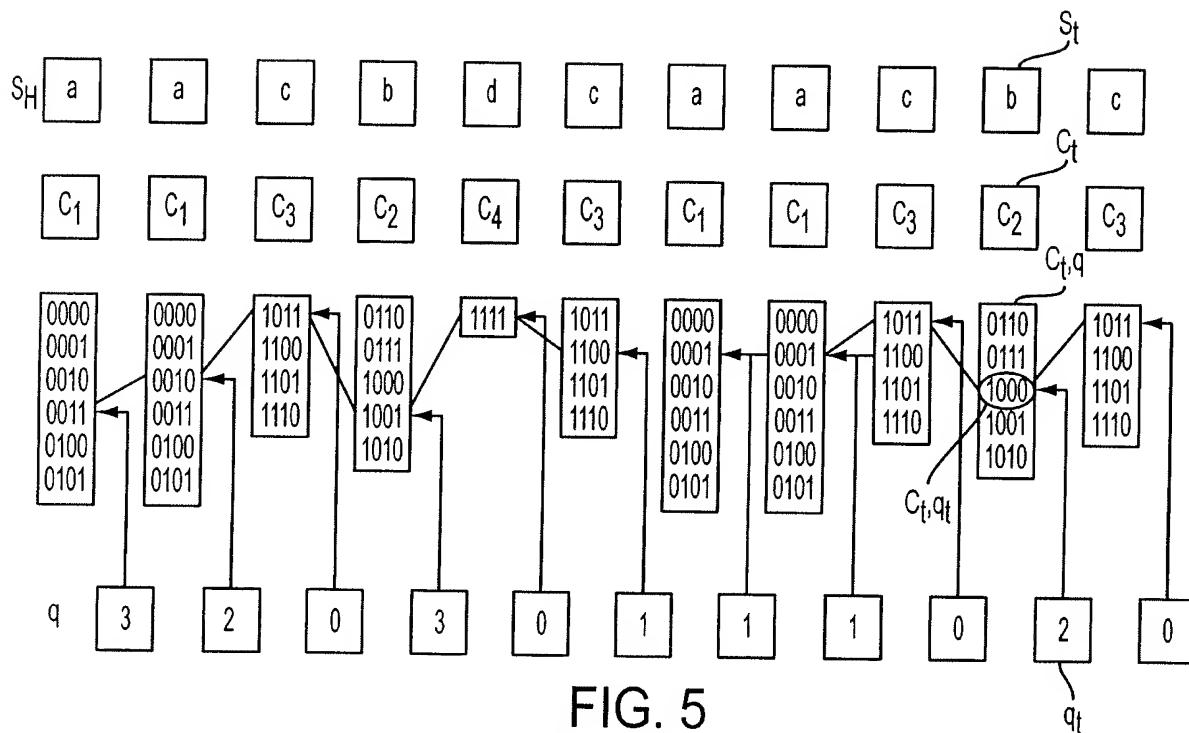Inventor(s): Herve JEGOU et al
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FIG. 5

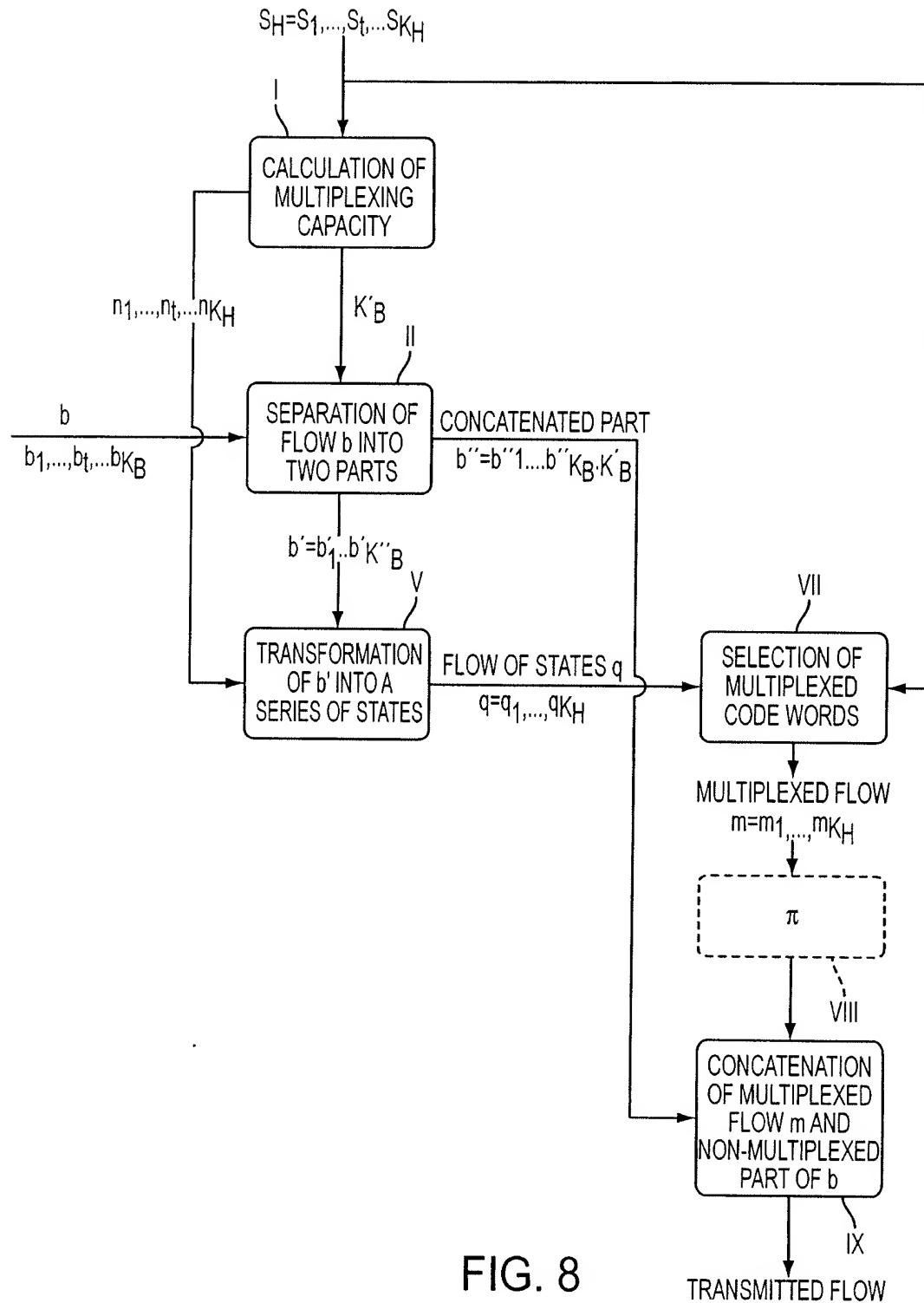| T_Z IDENTIFIER	U_{T_Z}	$V_{T_Z,1}$	$V_{T_Z,2}$	$V_{T_Z,3}$	O_{T_Z}
T_0	1	1	0	0	0.0000
T_1	15	0	8	1	0.0001
T_2	21	0	3	7	0.0004
T_3	19	0	12	0	0.0010
T_4	25	0	7	6	0.0011
T_5	24	0	2	9	0.0028
T_6	14	0	3	4	0.0030
T_7	18	0	7	3	0.0034
T_8	27	0	1	11	0.0047
T_9	17	0	2	6	0.0060
T_{10}	30	0	0	13	0.0062
T_{11}	20	0	1	8	0.0080
T_{12}	11	0	7	0	0.0086
T_{13}	23	0	0	10	0.0095
T_{14}	6	0	1	2	0.0381
T_{15}	3	0	2	0	0.0566
T_{16}	2	0	0	1	0.1610
$T_{Z_{max}} = T_{17}$	1	0	1	0	0.5850

FIG. 6

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$S_H = S_1, \ldots, S_t, \ldots S_{K_H}$

I

CALCULATION OF MULTIPLEXING CAPACITY

K'_B

$n_1, \ldots, n_t, \ldots n_{K_H}$

II

b

$b_1, \ldots, b_t, \ldots b_{K_B}$

SEPARATION OF FLOW b INTO TWO PARTS

CONCATENATED PART

$b'' = b''_1 \ldots b''_{K_B \cdot K'_B}$

$b' = b'_1 \ldots b'_{K''_B}$

V

TRANSFORMATION OF b' INTO A SERIES OF STATES

FLOW OF STATES q

$q = q_1, \ldots, q_{K_H}$

VII

SELECTION OF MULTIPLEXED CODE WORDS

MULTIPLEXED FLOW

$m = m_1, \ldots, m_{K_H}$

π

VIII

CONCATENATION OF MULTIPLEXED FLOW m AND NON-MULTIPLEXED PART OF b

IX

TRANSMITTED FLOW

FIG. 8

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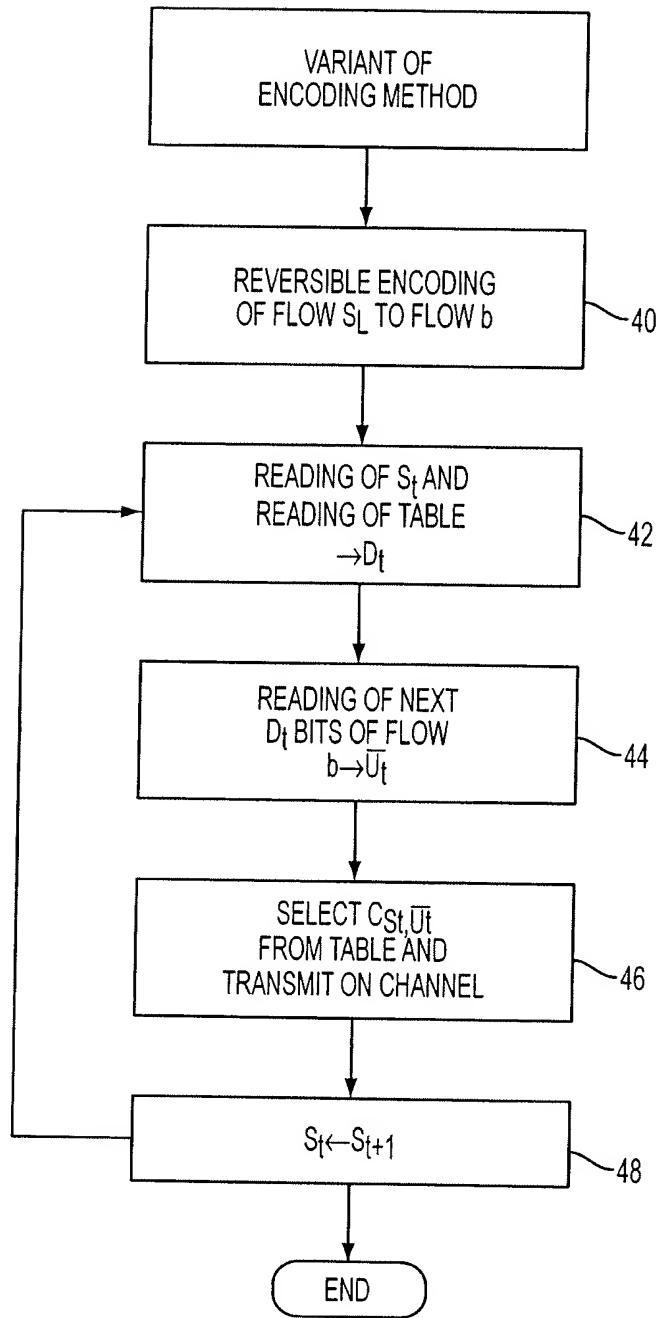Inventor(s): Herve JEGOU et al
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VARIANT OF
ENCODING METHOD

REVERSIBLE ENCODING
OF FLOW S_L TO FLOW b ───40

READING OF S_t AND
READING OF TABLE
→D_t ───42

READING OF NEXT
D_t BITS OF FLOW
b→$\overline{U}_t$ ───44

SELECT $C_{S_t,\overline{U}_t}$
FROM TABLE AND
TRANSMIT ON CHANNEL ───46

$S_t \leftarrow S_{t+1}$ ───48

END

FIG. 9

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11-B	12-B	13-B	18-B	14-B	15-B	17-B
CLASS C_i	$C_i, \overline{U_i}$	a_i	D_i	$N_i = Z^{1_i}$	μ_i	$\overline{U_i}$
C_1	000	a_1	1	2	0.30	0
	001					1
C_2	010	a_2	2	4	0.43	00
	011					01
	100					10
	101					11
C_3	110	a_3	0	1	0.25	Ø
C_4	111	a_4	0	1	0.02	Ø

FIG. 2B
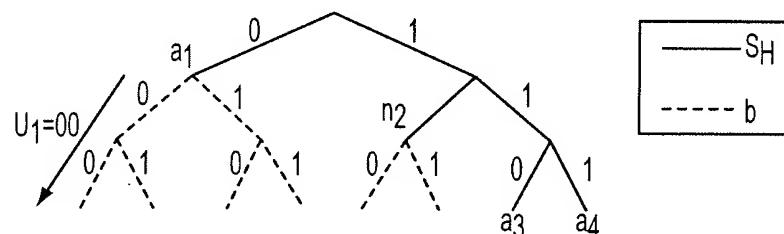
FIG. 7

S_t	a_2	a_1	a_1	a_3	a_1	a_2	a_1	a_4	a_2	a_1
PREFIX	10	0..	0..	110	0...	10.	0..	111	10.	0..
SUFFIX $\overline{U_t}$	..0	..10	.10	...	.10	.1	.01	...	..0	.10
m_t	100	010	010	110	010	101	001	111	100	010

FIG. 10

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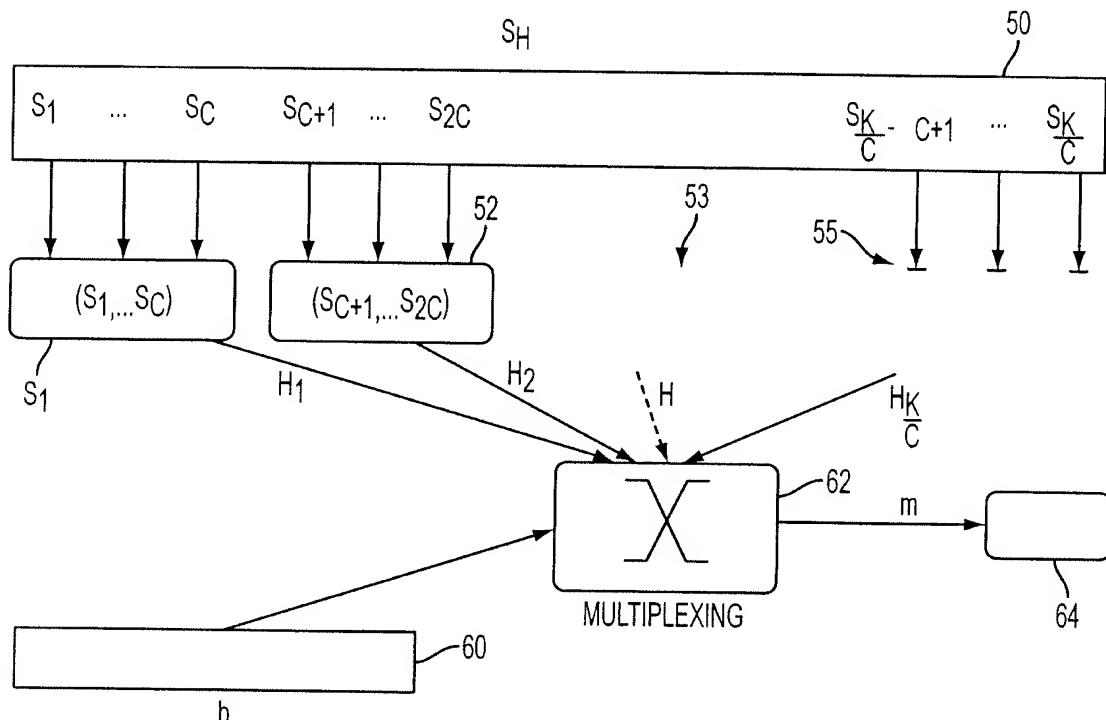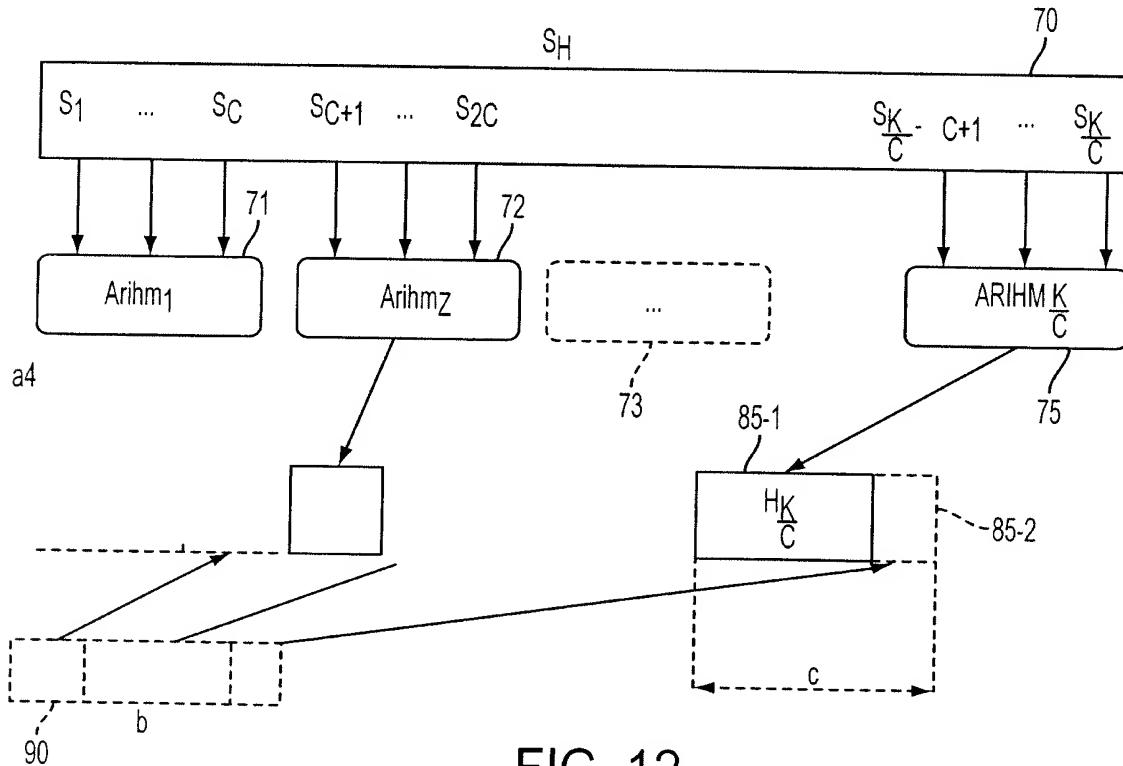Inventor(s): Herve JEGOU et al
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S_H 50

| S_1 | ... | S_C | S_{C+1} | ... | S_{2C} | | $S_{\frac{K}{C}}-C+1$ | ... | $S_{\frac{K}{C}}$ |

52   53   55

$(S_1,...S_C)$ $(S_{C+1},...S_{2C})$

S_1 H_1 H_2 H $H_{\frac{K}{C}}$

X   62   m

MULTIPLEXING   64

60

b

FIG. 11

S_H 70

| S_1 | ... | S_C | S_{C+1} | ... | S_{2C} | | $S_{\frac{K}{C}}-C+1$ | ... | $S_{\frac{K}{C}}$ |

71   72

Arihm$_1$ Arihm$_Z$ ...   ARIHM $\frac{K}{C}$

a4   73   85-1   75

$H_{\frac{K}{C}}$ 85-2

90   b   c

FIG. 12